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GLARE-PROTECTION DEVICE

The invention is in the field of glare-protection devices, which, for example, are utilized as viewing windows for protection masks, helmets or goggles for welders. It concerns a glare-protection device in accordance with the generic term of the first claim. The invention apart from this is also in the field of electro-magnetic compatibility (EMC) and concerns an EMC screening element for use in a glare-protection device, in accordance with the generic term of the further independent claim.

Modern glare-protection devices, which are utilized, for example, as viewing windows for protection marks, - helmets and - goggles for welders, as active filtering element typically contain at least one liquid crystal (LC) cell, which blocks the light transmission to a greater or lesser extent, as soon as the external light intensity exceeds a predefined threshold. For the detection of the light intensity a light sensor is utilized. An electronic circuit in the glare-protection device comprises an evaluation circuit for the sensor signal and a driving circuit for the liquid crystal cell.

The light sensor and the evaluation circuit detect so-called flickering light in the welding arc. Because in particular modern welding processes operate with very low current values, the signal to be detected has an extremely low signal to noise ratio. For this reason it is difficult to differentiate between the flickering light content and other light contents and to extract the signal to be detected from the sensor output. In order for the evaluation circuit to be capable of doing this, it has to be designed to be

very sensitive, i.e., with a high amplification. Such sensitive evaluation circuits, however, have the disadvantage, that they are also sensitive to electro-magnetic interference signals. Interfering electro-magnetic influences can, for example, be produced by radiation from electric motors, from power inverters (e.g., of welding installations), from mobile telephones, etc.

Efforts up until now to find a solution to this problem on the one hand applied themselves to the evaluation circuit itself. It was attempted to design it in such a manner, that it picks up as few interfering signals as possible, in that, for example, critical conductor tracks are designed to be as short as possible.

On the other hand, one has recognized, that the evaluation circuit also should be screened towards the outside against electro-magnetic interference. In doing so, one up to now concentrated on the „outside„ or „front side„ of the glare-protection device, i.e., on that side, which is facing away from the carrier person and facing towards that side, from which electro-magnetic interference signals are primarily expected. A common measure against such interference signals consists in equipping with electronic components only that side of the circuit board, which is facing inwards and to leave the surface facing outwards free of any components; simultaneously the external surface of the circuit board without any components is equipped with electro-magnetic screening means. Such screening means typically are a fine-mesh screen made of metallic conductor tracks. While these measures do produce some improvements, it has, has, however, become manifest, that the EMC-screening achieved in this manner is still unsatisfactory for particularly sensitive circuits.

It is therefore the objective of the invention to screen the evaluation circuit or parts of it from interfering electro-magnetic influences or interfering radiation in a better way

than by the measures common up until now. The objective is achieved by the glare-protection device in accordance with the invention and by the screening element in accordance with the invention, as they are defined in the independent claims.

The idea of the invention is based on electro-magnetically screening the electronic components of the evaluation circuit not only on the side of the printed circuit board without any components („from outside„), but also on the side of the circuit board containing components („from inside„). Foreseen therefore is an additional „protection behind the front„. This measure in accordance with the invention leads to essential improvements in comparison with the up to the present moment usual protection „at the front„.

The glare-protection device in accordance with the invention contains an active filtering element with a light transmission from an external half-space into an internal half-space, which can be influenced, and electronic components for the influencing of the filtering element, which are attached to at least one surface of a circuit board. The glare-protection device furthermore comprises a screening element containing electrically conductive material for the screening of electronic components against electro-magnetic radiation, which screening element is affixed to the at least one surface of the printed circuit board.

The screening elements in accordance with the invention for utilization in the glare-protection device in accordance with the invention contains electrically conductive material and has a concave shape.

The invention makes it possible to design the evaluation circuit to be exceedingly sensitive, without it being excessively subjected to interference by electro-magnetic

influences. Interfering electro-magnetic influences on the one hand, as described above, emanate from the surroundings of the glare-protection device („external interaction„). On the other hand, it has become manifest, that interfering electro-magnetic influences can also be produced within the glare-protection device itself, for instance in the driving circuit for the LC - cell. This is because glare-protection devices of today utilize digital modules, which generate interfering electro-magnetic radiation and also emit these to their surroundings. Also the LC cell itself can exercise undesirable electro-magnetic influences on the evaluation circuit. This „internal interaction„ is a problem in particular, when the glare-protection device has to be implemented in a small space. The concept in accordance with the invention „protection behind the front„ makes possible a protection also against the „internal interaction„. This at first unexpected advantage is obviously jointly responsible for the exceptional effectiveness of the invention.

In many instances, the invention even makes possible a simplification of the evaluation circuit, because thanks to the EMC - screening one can make do without certain electronic filter elements. A further benefit of the invention consists in the fact, that the screening protects the circuit not only against electro-magnetic radiation, but also against other detrimental physical and/or chemical influences, for example, against perspiration vapours from the carrier person.

In the following, the invention is explained in detail on the basis of drawings. These show:

Fig. 1 an exploded view drawing of a glare-protection device with an evaluation circuit screened in accordance with the invention,

Fig. 2 a plan view of the exploded view glare-protection device of Fig. 1 and

Fig. 3 an evaluation circuit screened in accordance with the invention in a view from the front (a), from the long side (b), from the rear (c) as well as from the transverse side (d).

Figures 1 and 2 in an exploded view drawing, resp., in a plan view show an exemplary embodiment of a glare-protection device in accordance with the invention. **Figure 3** illustrates the electronic circuit with an evaluation circuit of the glare-protection device in accordance with the invention of Figures 1 and 2 screened in accordance with the invention; in it, (a) depicts a view from the outside, (b) a view from above, (c) a view from inside and (d) a view from the side. In Figure 3, exemplary dimensions of the components are indicated in millimetres. In the following, this exemplary embodiment is explained making reference to the three Figures, whereby the same reference marks designate the same components.

The glare-protection device as its core component comprises an optical module 1 with an active filtering element 11, typically containing at least one liquid crystal cell, which blocks to a greater or lesser extent the light transmission from an external half-space 91 into an internal half-space 92 through the optical module 1. The glare-protection device further contains a printed circuit board 2. An external surface 21 of the printed circuit board 2 is equipped with (not shown in the drawing) screening means, for example, a fine-mesh screen made of metallic conductor tracks, for the purpose of screening against electro-magnetic radiation from the outside. On an internal surface 22 of the printed circuit board, an electronic circuit 3 is affixed. The electronic circuit 3 can, for example, comprise two part circuits 31, 32, an evaluation circuit 31 and a driving circuit 32. Attached to the printed circuit board is also a light sensor 5 for the detection of the external light intensity, which can be covered with a covering plate 51. The evaluation circuit 31 serves for the evaluation of the sensor output signal, the driving circuit 32 for driving the liquid crystal cell 11 in dependence of the sensor output signal. On the printed circuit board 2, electric

energy storage devices 6.1, 6.2, such as batteries, can be installed. For the power supply, resp., for the charging of the batteries 6.1, 6.2, on the front side of the glare-protection device photo-electric cells, resp., solar cells 7.1, 7.2 can be foreseen. Belonging to the glare-protection device is in preference a cassette consisting of a cassette external part 81 and a cassette internal part 82, for example, made of plastic material. The cassette external part 81 is equipped with apertures 83, 84, 85.1, 85.2 for viewing, for the light sensor 5, resp., for the solar cells 7.1, 7.2, the cassette internal part 82 with an aperture 86 for viewing.

Above the evaluation circuit 31, on the internal surface 22 of the printed circuit board 2, a screening element 4 in accordance with the invention is attached. It is shaped in such a manner, that it covers the evaluation circuit 31 or also only parts, resp., components of it. In preference, it has a concave shape in the manner of a hood, so that it can cover electric and/or electronic components such as conductor tracks, contacts, resistances, capacitors, inductances, transistors, integrated circuits, etc. In the example of an embodiment illustrated here, the screening element 4 comprises an in essence rectangular plate 41 with a surface area of approx. 35,9 mm^2 and a thickness of approx. 0.5 mm, as well as at least partially protruding edges 42 of approx. 1.5 mm height, which are arranged along the circumference of the plate 41. These edges 42 are attached on the internal surface 22 of the printed circuit board 2 and materially positively connected with it in preference irreversibly, for example by means of soldering, gluing, spot welding, ultrasound welding, mechanical friction, etc. However, also non-positive or frictional connections are possible. With these, the screening element 4 can be reversibly attached to the printed circuit board 2, removed as and when so required and possibly re-attached at another point.

The screening element 4 must contain electrically conductive material, in order to in the manner of a Faraday's cage keep electro-magnetic interfering influences away from the evaluation circuit 31. It can, for example, consist of metal, of a plastic

material metallized on one surface, of plastic material packed with metal particles, of flexprint (i.e., a plastic foil, onto which electric conductor tracks are affixed), etc. Screening elements 4 made of metal can, for example, be made out of copper, brass, galvanized sheet metal, μ-metal (i.e., a ferro-magnetic foil, e.g., made out of $Fe_{40}Ni_{40}B_{20}$ (atom %)) or of mixtures of these. Mentioned here as exemplary materials for the screening elements made out of plastic materials shall be PVC or Stat-Kon® RC-1006 (manufacturing company: LNP Engineering Plastics Inc., Exton, PA). Suitable as materials for the metallization of plastic for screening elements 4 are, for example, aluminium, copper, tin or mixtures of these. The screening element 4 can be manufactured as a foil, an injection moulded part, moulded part or a punched out - and bent to shape part.

In a preferred embodiment, the screening element 4 is electrically connected with electrically conductive elements on the printed circuit board 2 and its electric potential set to their zero conductor (mass). In this manner, capacitive influences are also screened. For this purpose, the screening element 4 is connected with the printed circuit board 2, for example, by soldering, gluing with a conductive adhesive, spot welding, ultrasound welding, mechanical friction, etc.

In another embodiment, the electronic circuit 3 or parts of it could be attached to the outside of the printed circuit board 2 and screened with a screening element in accordance with the invention. Also belonging to the object of the invention are embodiments with several screening elements 4, which are attached either to a surface 21, 22 or both to the internal surface 22 as well as to the external surface 21 of the printed circuit board 2. The printed circuit board 2 can also be designed to be rigid or also flexible, i.e., as a foil printed circuit board; in case of a flexible printed circuit board 2, in preference a flexible screening element 4, for example made out of a foil, is utilized. With knowledge of the invention, the specialist can derive further embodiments from the examples indicated here.